EFFECT OF WAVELENGTH COMPOSITION OF LIGHT ON THE ACCUMULATION OF NITROGENOUS COMPOUNDS

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Introduction

Experiments reporting on the effect of different ranges of wavelengths have pointed out, more or less unanimously, that shorter wavelengths of light tend to promote the synthesis of nitrogenous compounds. To account for these observations several authors suggest that path of the photosynthetically assimilated carbon is influenced by variations in wavelength (Cayle—Emerson, 1957; Nichiporovich, 1958; Voskresenskaya—Grishina, 195,; Hauschild et al., 1962 a, b; Tolbert, 1963; Voskresenskaya, 1965).

At an explanation like that presents no small problem a fact that treatments of different wavelength, even if applied with an identical light intensity or incident quantum number, result in a different CO_2 fixation, resp. accumulation of dry matter. The quantitative changes mentioned above goes, in itself, with the change of the products of photosynthesis (Nichiporovich, 1963; Voskresenskaya—Grishina, 1958, 1959; Hauschild et al., 1962a).

Exeperiments ensuring an identical photosynthetic intensity did not give any unambiguous answer. Thus Hauschild et al. (1962a) mention the decrease of glycin, serin and glycolic acid simultaneously with the increase of asparaginic acid under the influence of blue light, which changes have compensated one another. Tregunna et al. (1962) have observed a marked decrease of glycin and, in a smaller degree, that of serin in blue light. Voskresenskaya and Grishina (1959) have obtained, even under such conditions, in the leaves of beans, and Voskresenskaya and Nechaeva (1966) in those of barley a higher protein content in blue light.

In the experiments to be reported now we have investigated the effect of different wavelength composition of light on the accumulation of nitrogenous compounds.

Material and methods

Bean plants (cult. Surecrop) were grown under fluorescent lamps of different wavelength distribution of radiant energy till an age of five weeks. Illumination has varied between the limits 30 000—120 000 erg/sq. cm. sec. In our equipment (Horváth, 1964) the temperature

has changed between 15—25 °C, the vapour content between 40—70 percent, in a given daily rhythm. The plants were grown in sand culture using PRYANISHNIKOV's nutrient solution.

From the dry material of plants water-soluble and protein nitrogen fractions, precipitated by TCA were isolated. After digestion by sulfuric acid nitrogen determination have been carried out by direct Nesslerization (KELLEY et al., 1946).

Results

The soluble nitrogen content, taking place by an identical incident quantum number, is illustrated in Fig. 1. Although the values in several organs are different and depending also upon light intensity, the amount of the soluble nitrogen fraction has decreased in every organs in the order of green, red and blue light. Thus wavelength composition has produced unequivocal effect.

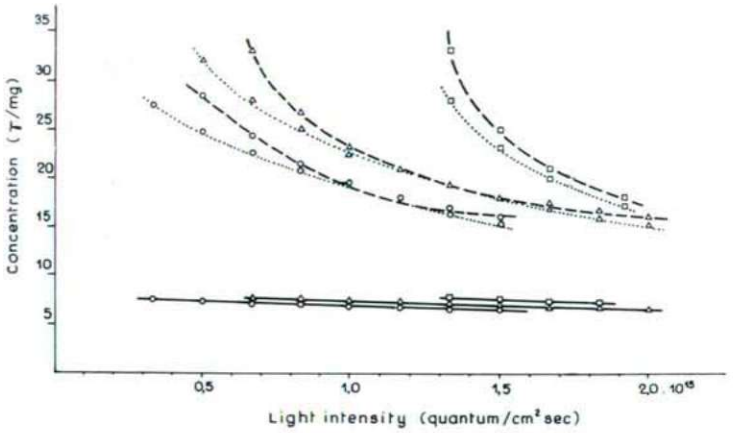

Fig. 1. Effect of wavelength composition of light on the soluble nitrogen content. o, blue; △, red; □, green light; ——, root; - - -, stem; . , . , leaf.

The protein nitrogen content has not been influenced neither by wavelength composition nor by light intensity. Only the difference of several organs was measured. The protein nitrogen level has varied about 14 γ/mg in the root, 9 γ/mg in the stem, and 20 γ/mg in the leaf.

Discussion

As the protein nitrogen has not shown any change the soluble nitrogen fraction will be considered by interpreting the effect of wavelength composition of light.

Under our experimental conditions it was observed, in the case of an identical accumulation of dry matter, that soluble nitrogen content is not touched by variations in wavelength (Fig. 2). The data also indicate that increasing dry matter accumulation accompanies the decrease of soluble nitrogen content.

Accordingly we consider the effect of wavelength composition in the fact of changing the course of the accumulation of dry matter (Fig. 3). If the increase in dry matter production has an effect on the proportion of some compounds, so the influence of wavelength composition is manifest. In the present case this is true of the soluble nitrogen fraction. If the increase in the amount of produced dry matter does not show any relationship to the proportion of

1) As related to an identical incident quantum number, the soluble nitrogen content has decreased in every organ in the order of green, red and blue light.

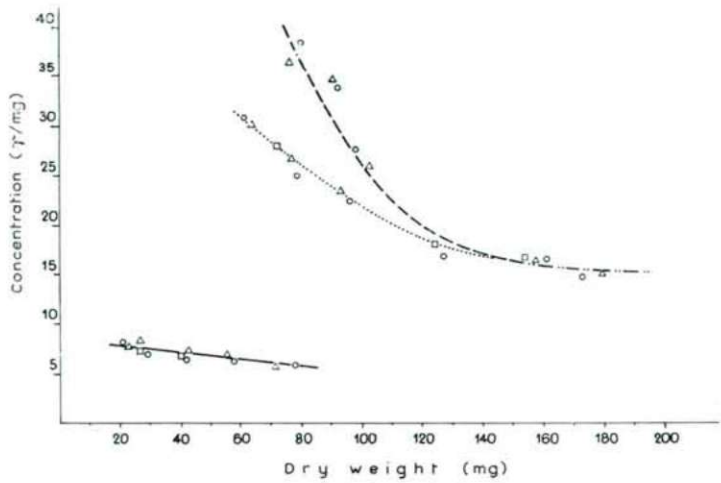

Fig. 2. Effect of dry matter accumulation on the soluble nitrogen content. Marking is the same as at Fig. 1.

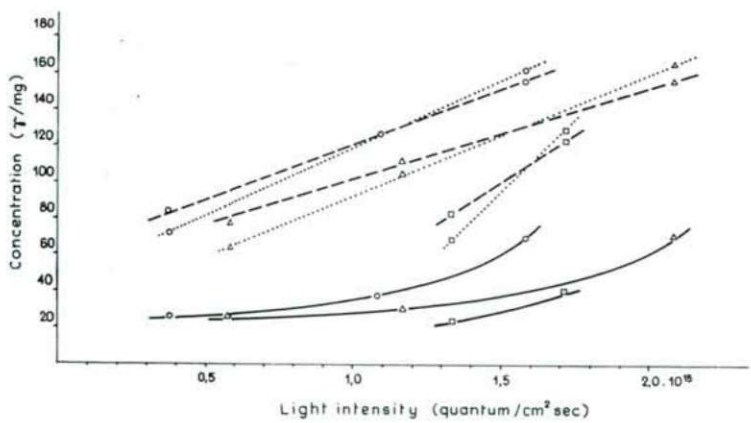

Fig. 3. Effect of wavelength composition of light on the accumulation of dry matter. Marking is the same as at Fig. 1.

2) The level of protein ntirogen remained constant.

3) We interpret the effect of wavelength composition of light in the fact of changing the course of the accumulation of dry matter.

any compound, so wavelength composition has no effect. That has been experienced of the protein nitrogen content.

The high ntirogen content, produced in blue light and cited in the literature, could not been found in our experiment. We explain this fact so, referring to data in Fig. 2, that dry matter production in blue light was greater than in red and green ones. These data are in accord with the observations of HOOVER (1937), KLESCHNIN (1960) and MCLEOD (1961). VOSKRESENSKAYA (1952, 1961), on the other hand, has found consistently a higher photosynthetic activity in red light.

Summary

Investigatigations on the effect of wavelength composition of light upon the accumulation of nitrogenous compounds have been carried out growing plants under controlled conditions for several weeks. The investigations indicate:

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